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In re Patent Application of

John Barry

Application No.: 10/808,457 Group Art Unit: 3672

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Confirmation No.: 4856

Title: DRILL BIT AND DRILL TIP HAVING A TIP-LOCATING STRUCTURE

SUBMISSION OF CERTIFIED COPY OF PRIORITY DOCUMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The benefit of the filing date of the following priority foreign application(s) in the following foreign country is hereby requested, and the right of priority provided in 35 U.S.C. § 119 is hereby claimed.

Country: AUSTRALIA

Patent Application No(s).: 2003.203447

Filed: March 28, 2003

In support of this claim, enclosed is a certified copy(ies) of said foreign application(s). Said prior foreign application(s) is referred to in the oath or declaration and/or the Application Data Sheet. Acknowledgment of receipt of the certified copy(ies) is requested.

Respectfully submitted,

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Patent Office
Canberra

I, JULIE BILLINGSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Complete specification in connection with Application No. 2003203447 for a patent by SANDVIK AB as filed on 28 March 2003.

WITNESS my hand this
Twenty-third day of March 2004

JULIE BILLINGSLEY
TEAM LEADER EXAMINATION
SUPPORT AND SALES

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AUSTRALIA

Patents Act

COMPLETE SPECIFICATION
(ORIGINAL)

Class Int. Class

Application Number:
Lodged:

Complete Specification Lodged:
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Priority

Related Art:

Name of Applicant:

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Invention Title:

DRILL BIT

Our Ref : 689697
POF Code: 375057/11209

The following statement is a full description of this invention, including the best method of performing it known to applicant(s):

DRILL BIT

The present invention relates to a drill bit, in particular for the drilling of rock. The invention further extends to roof bolts of the self-drilling kind.

Roof bolts are commonly employed in the underground mining industry to support the walls and/or the roof of excavated tunnels and openings against fragmentation and collapse. Roof bolts typically are applied by first drilling a hole in the rock wall and thereafter inserting the roof bolt therein. The bolt is fixed within the hole normally by a settable glue, such as a resin or a mortar cement.

Drill rods typically have a separate drill bit assembly, comprising a drill bit and a cemented carbide tip, which is fixed to the rod at one end thereof. The other end of the rod includes an arrangement for cooperating with a driving assembly, such as a hydraulic or pneumatic drill. The drill bit typically is cast from steel, and machined as required, and a cemented carbide drill tip is fixed to the drill bit, preferably concentrically, and extends normally beyond both the leading end of the drill bit and beyond the side periphery of the bit, to engage the rock and perform the cutting action during a drilling operation.

Typically a drill tip is bonded to one end of the drill bit, by welding, soldering or brazing, with brazing being most common. In the manufacture of a drill bit assembly, the drill tip is located in place relative to the drill bit and the brazing operation, or other operation as required to bond the tip to the drill bit, is thereafter performed. Unfortunately however, the bonding operation often interferes with the correct placement of the tip relative to the drill bit and the resultant drill bit is formed with the drill tip non-concentrically located relative to the drill bit. While slight concentricity error is acceptable, more substantial concentricity error generally results in the drill bit being rejected.

Rejection of inaccurately formed drill bits results in a significant expense to drill bit manufacturers and therefore a reduction in that rejection rate is

desirable. Also, an improvement in the ease of bonding drill tips to drill bits is additionally desirable.

It is an object of the present invention to overcome, or at least alleviate one or more of the above disadvantages. It is a particular object of the invention, to provide an arrangement, in which the rejection rate of drill bits to which cemented carbide tips are bonded, is lowered.

A drill bit assembly including a leading end to which a drill tip is fixed by bonding, said drill tip having a top cutting edge, a pair of side cutting edges, a bottom edge and a pair of parallel side walls extending between said respective edges, said leading end being arranged to support said drill tip along said bottom edge and against said parallel side walls thereof, said drill bit including a bore extending axially therethrough and opening into said leading end and said drill tip extending across said bore but permitting egress of flushing liquid from said bore at said leading end, and said drill tip being arranged to cooperate with an engagement face formed at said leading end to locate said drill tip in a bonding position relative to said leading end prior to bonding of said drill tip to said leading end, said cooperation being such as to resist shifting movement of said drill tip along said bottom edge thereof away from said bonding position.

A drill bit according to the present invention advantageously establishes the drill tip as concentric relative to the drill bit prior to bonding. The cooperation between the tip and the drill bit is such as to maintain the concentric position of the tip relative to the drill bit, while the drill bit is positioned in the relevant bonding equipment, and thereafter as bonding takes place. The tip is therefore accurately positioned concentrically with respect to the drill bit until such time as bonding has been achieved and the tip is permanently fixed to the drill bit. Accordingly, unless the mechanical cooperation between the drill tip and the drill bit fails, then the drill tip is reliably positioned relative to the drill bit for bonding thereto. This means that the rejection rate of drill bits on the basis of concentricity error is either eliminated, or substantially reduced.

It is not intended that the cooperation between the drill tip and the drill bit be such as to prevent lifting movement of the tip away from the drill bit. The cooperation is to prevent shifting movement along the bottom edge of the drill tip. That is the movement which results in the type of rejection of drill bit assemblies to which the invention is concerned. However, the invention may extend to arrangements that resist lifting movement.

A further advantage of the invention is that the cooperation between the drill tip and the drill bit can increase the strength of the bond formed between those parts, compared to the bond strength of prior art arrangements. The improvement may however be in certain directions only, depending on the type of cooperating arrangement employed.

In a preferred form of the invention, the drill tip includes a projection which cooperates with the engagement face of the leading end of the drill bit for securely locating the drill tip relative to the leading end.

In a highly preferred form of the invention, the leading end of the drill bit includes a pair of axially extending abutment elements, each of which includes an abutment face for engagement with an opposite side of the drill tip. The leading end further includes a support face which extends generally laterally from each abutment face for supporting the bottom edge of the drill tip. Each abutment element further defines an inwardly facing engagement face which extends axially from said support face, and the respective engagement faces are arranged in spaced-apart, opposed facing relationship. The bore which opens into the leading end, is principally for the discharge of flushing medium therethrough, and in use, is aligned with a lengthwise bore formed in a drill rod to which the drill bit assembly is attached. In this preferred embodiment, the support face of each abutment element is axially spaced downstream of the open end of the bore at the leading end, so that the bottom edge of the drill tip when supported thereon, is spaced from the open end of the bore, so that the drill tip does not obstruct the egress of flushing liquid through the open end. In this embodiment the drill tip includes a projection which cooperates by abutment with each of the engagement faces of the abutment elements in order to

accurately locate the drill tip in the bonding position. In a preferred arrangement, the projection of the drill tip extends from the bottom edge of the tip.

In each of the above embodiments in which either a single engagement face or a pair of engagement faces are provided, each may be formed as an extension of the internal surface of the drill bit bore. Alternatively, the or each engagement face may be formed as part of the internal surface of the drill bit bore, generally at the end of the bore which opens into the leading end. In that arrangement, to ensure that the flushing medium can egress through the bore at the leading end, it is preferable that the thickness of the drill tip is less than the diameter of the bore at the leading end, so that the bore remains open at the leading end despite the drill tip extending across the bore and despite the or each projection extending into the bore to engage the internal surface thereof.

In the above embodiment, the projection is constructed to be generally of the same thickness as the thickness of the drill tip measured between the parallel side walls of the tip and the projection further has a length along the bottom edge, which is slightly less than the spacing between the engagement faces.

In an alternative embodiment, the drill tip can include a pair of spaced-apart projections extending from the bottom edge, and each of the projections is arranged for engagement respectively with an engagement face. The present invention further extends to drill tips separate from a drill bit, and to drill rods or roof bolts, which have a drill bit assembly of the above described kind. The drill bit assembly can be formed integrally with the drill rod or roof bolt, or can be connected thereto in any suitable manner.

It is to be noted that the invention is applicable to single piece or "spade" type drill tips, as well as to two-piece tips known as "wing tips". It may be however, that the type of cooperating location differs depending on the use of a spade tip or a wing tip. For example, it would be unlikely for a wing tip to include a pair of projections which extend from the bottom edge thereof to

engage the internal surface of a bore formed in the drill bit at diametrically opposed positions. More likely, a wing tip will include a single projection extending from the bottom edge, but is may also include a second or more projections as required, that extend elsewhere, such as from a face thereof that abuts against the abutment face. This is an example only, and any arrangement of projections is possible and within the scope of the invention. Likewise, a spade tip may include a single projection, or two or more projections as required.

The attached drawings show an example embodiment of the invention of the foregoing kind. The particularity of those drawings and the associated description does not supersede the generality of the preceding broad description of the invention.

Figures 1 to 3 show exploded views of a drill bit assembly according to the invention.

Figures 4 to 6 show assembled views of the drill bit assembly shown in figures 1 to 3.

The figures show a drill bit assembly comprising a drill tip 10 and a drill bit 11, to which the tip 10 is shown connected to in Figures 4 to 6. The drill tip 10 includes a pair of cutting edges 12 which are inclined towards a central apex, and a pair of side cutting edges 13.

The drill bit 11 is formed with a trailing spigot 14 which is cylindrical and which is arranged to be received in the leading end of a drill rod for fixing therein. The spigot 14 can include an outer thread for threaded engagement with a drill rod, or it may be otherwise fixed to the drill rod, such as by welding.

The drill bit 11 includes a central bore 15 which extends through the bit 11 and opens into the leading end 16 of the bit 11. The bore 15 is a flushing bore which facilitates transport of flushing medium through the leading end during a drilling operation, to flush debris from the leading end.

The leading end 16 includes a pair of axially extending abutment elements 17, and each abutment element includes an abutment face 18. The abutment faces face in opposite directions, and are arranged to engage opposite faces of the drill tip 10. This arrangement is most clearly shown in Figure 5, which shows the drill tip 10, extending fully across the leading end 16 of the drill bit 11 and in contact with each of the abutment faces 18.

Support faces 19 extend generally laterally at the base of each of the abutment faces 18, to support the bottom edge 20 of the drill tip 10. One of the support faces 19 is most clearly shown in Figure 2, while an equivalent support face 19 extends from the other of the abutment elements 17, but in the opposite direction.

A pair of parallel side walls 26 extend between the respective edges 12, 13 and 20 on each side of the drill tip 10.

In the drill bit assembly, the drill tip 10 is positioned to extend across the drill bit 11 as shown in Figure 5, so that each of the side edges 13 extends beyond the external periphery 21 of the drill bit 11 and the apex 22 between the cutting edges 12 is generally aligned with the longitudinal axis of the bore 15. Moreover, the drill tip 10 is positioned so that the bottom edge 20 thereof is supported downstream of the opening of the bore 15. This arrangement is clearly shown in Figure 6, in which the bottom edge 20 of the drill tip 10 is shown spaced from the opening of the bore 15.

Figure 5 shows a correctly assembled drill bit 11 with the drill tip 10 in the position described above. In this position, the drill tip 10 is correctly positioned for bonding to the drill bit 11. However, it is the case that correct positioning is difficult to achieve consistently, given that the drill tip 10 in prior art arrangements, is not mechanically located relative to the drill bit 11 and therefore can shift relative to the drill bit 11 during handling of the assembly and during the bonding process which is used to bond the drill tip 10 to the drill bit 11. Accordingly, assembled drill bits are often formed in which the apex 22 is

not properly aligned with the longitudinal axis of the bore 15 and in such cases, the side cutting edges do not equally extend beyond the periphery 21 of the drill bit 11. In some cases, only one of the side cutting edges 13 extends beyond the periphery 21, and in such cases, the drill bit assembly is required to be rejected.

According to the embodiment of the invention which is illustrated in the figures, the drill tip 10 includes a pair of projections 23 which extend from the bottom edge 20 of the drill tip 10 and which have a radially facing outer edge 24 which is positioned to engage against engagement faces 25 which extend from the inside surface of the bore 15 and which form an inwardly facing surface of each abutment element 17. One engagement face 25 is shown in Figure 2, while an opposed engagement face 25 is shown in Figure 3. The assembled arrangement is most clearly shown in Figure 6, in which the left hand projection 23 is shown snugly engaging against the engagement face 25. It will be clear from the figures, that when the drill tip 10 is placed in the correct bonding position shown in Figure 5, that the radially facing outer edges 24 (Figure 3) of the projections 23, each engage an engagement face 25 at diametrically opposed positions. That engagement restrains the tip 10 from shifting movement along the bottom edge of the tip 20, which would shift the apex 22 out of alignment with the axis of the bore 15 and therefore the drill tip 10 is accurately positioned and is unlikely to shift to an inaccurate position.

The main requirement for fixing the position of the drill tip 10 relative to the leading end 16, is to eliminate movement of the drill tip 10 during the brazing operation. The arrangement shown in the drawings facilitates this, although it is acceptable that the projections 23 loosely engage the engagement faces 25 as very slight movements of the drill tip 10 are acceptable. What is not acceptable is larger movements which cause the drill tip 10 to be substantially misaligned relative to the drill bit 11.

It will be appreciated that a wide variety of different arrangements can be adopted to achieve the result of the embodiment shown in the drawings. Accordingly, while two projections 23 are shown, a single projection which

extends between the engagement faces 25 could be provided. Alternatively, a single projection 23, which engages only one engagement face may be acceptable. Therefore, a wide variety of mating arrangements can be provided. The illustrated embodiment however is particularly advantageous, because it requires minimum change to existing arrangements, and the change which is made to the drill tip, to introduce each of the projections 23, is relatively simple.

The invention described herein is susceptible to variations, modifications and/or additions other than those specifically described and it is to be understood that the invention includes all such variations, modifications and/or additions which fall within the spirit and scope of the above description.

The claims defining the invention are as follows:

1. A drill bit assembly including a leading end to which a drill tip is fixed by bonding, said drill tip having a top cutting edge, a pair of side cutting edges, a bottom edge and a pair of parallel side walls extending between said respective edges, said leading end being arranged to support said drill tip along said bottom edge and against said parallel side walls thereof, said drill bit including a bore extending axially therethrough and opening into said leading end and said drill tip extending across said bore but permitting egress of flushing liquid from said bore at said leading end, and said drill tip being arranged to cooperate with an engagement face formed at said leading end to locate said drill tip in a bonding position relative to said leading end prior to bonding of said drill tip to said leading end, said cooperation being such as to resist shifting movement of said drill tip along said bottom edge thereof away from said bonding position.

2. A drill bit assembly according to claim 1, said drill tip including a projection for cooperating with said engagement face.

3. A drill bit assembly according to claim 2, said leading end including a pair of axially extending abutment elements each of which includes an abutment face for engaging and supporting a respective one of said parallel side walls, and a support face extending generally laterally from each said abutment face for supporting said bottom edge of said drill tip, and each said abutment element defining an inwardly facing engagement face which extends axially from said support face and said engagement faces being spaced-apart in opposed facing relationship and said projection extending from said bottom edge of said drill tip for engagement with said engagement faces of said abutment elements.

4. A drill bit assembly according to claim 3, said projection being generally of the same thickness as said drill tip between said parallel side walls and having a length slightly less than the spacing between said engagement faces.

5. A drill bit assembly according to claim 3, said drill tip including a pair of spaced-apart projections extending from said bottom edge, said projections engaging respectively against said engagement faces.

6. A drill bit assembly according to any preceding claim, said engagement face, or said engagement faces, being formed as an extension of the internal surface of said bore.

7. A drill bit assembly according to claim 1 or 2, said engagement face being formed by an internal surface of said bore.

8. A drill bit assembly according to claim 7, including a projection extending from said bottom edge and extending across said bore to engage said internal surface at a pair of engagement faces which are diametrically opposed.

9. A drill bit assembly according to claim 7, including a pair of spaced apart projections extending from said bottom edge for engagement with said internal surface at a pair engagement faces which are diametrically opposed.

10. A drill bit assembly according to claim 8 or 9, wherein the thickness of said drill tip and of any projection that extends from said bottom edge, is less than the diameter of said bore at said leading end.

11. A drill rod including a drill bit attached to one end thereof, said drill bit being formed in accordance with any one of claims 1 to 10.

12. A drill tip for a self drilling rock or roof bolt to which the drill tip is fixed by bonding, said drill tip including a pair of top cutting edges which are inclined toward a central apex, a pair of side cutting edges, a bottom edge, and a pair of parallel side walls extending between said respective edges, said bottom edge having locating means to locate said drill tip relative to said bolt in a bonding position prior to bonding, to resist shifting movement of said drill tip along said bottom edge away from said bonding position, said locating means being

arranged to cooperate with an engagement face which is formed at a leading end of the bolt at which end said drill tip is to be bonded.

13. A drill tip according to claim 12, said locating means comprising a projection extending from said bottom edge for engaging with said engagement face.

14. A drill tip according to claim 13, said projection being arranged to engage a pair of inwardly facing engagement faces which are spaced apart in generally opposed facing relationship, and said projection being generally of the same thickness as said drill tip between said parallel side walls and having a length slightly less than the spacing between said engagement faces.

15. A drill tip according to claim 12, said drill tip including a pair of spaced-apart projections extending from said bottom edge, said projections being arranged to engage a pair of inwardly facing engagement faces which are spaced apart in generally opposed facing relationship.

DATED: 28 MARCH 2003

PHILLIPS ORMONDE & FITZPATRICK

ATTORNEYS FOR:

SANDVIK AB

David B Fitzpatrick

ABSTRACT

A drill tip and a drill bit assembly including a leading end 16 to which a drill tip 10 is fixed by bonding. The drill tip 10 has a top cutting edge 12, a pair of side cutting edges 13, a bottom edge 20 and a pair of parallel side walls 26 extending between the respective edges. The leading end 16 being arranged to support the drill tip 10 along the bottom edge 20 and against the parallel side walls 26. The drill bit 10 including a bore 15 extending axially therethrough and opening into the leading end 16 and the drill tip 10 extending across the bore 15 but permitting egress of flushing liquid from the bore 15 at the leading end 16. The drill tip 10 being arranged to cooperate with an engagement face 25 formed at the leading end 16 to locate the drill tip 10 in a bonding position relative to the leading end 16 prior to bonding of the drill tip 10 to said leading end16. The cooperation being such as to resist shifting movement of the drill tip 10 along the bottom edge 20 away from the bonding position.

FIG 1

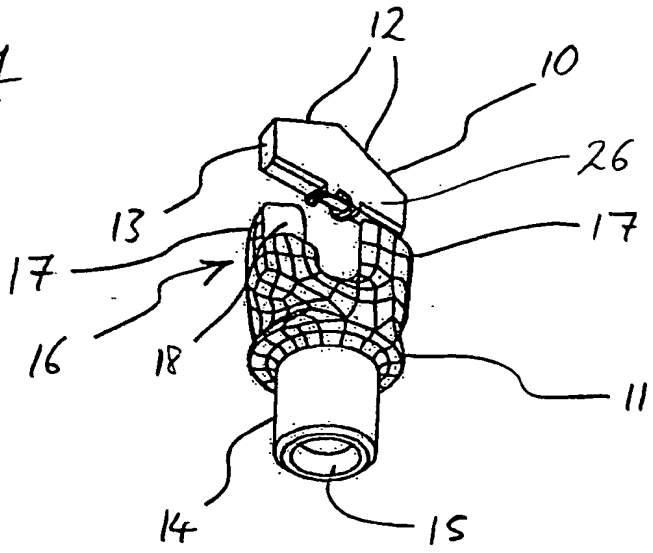

FIG 2

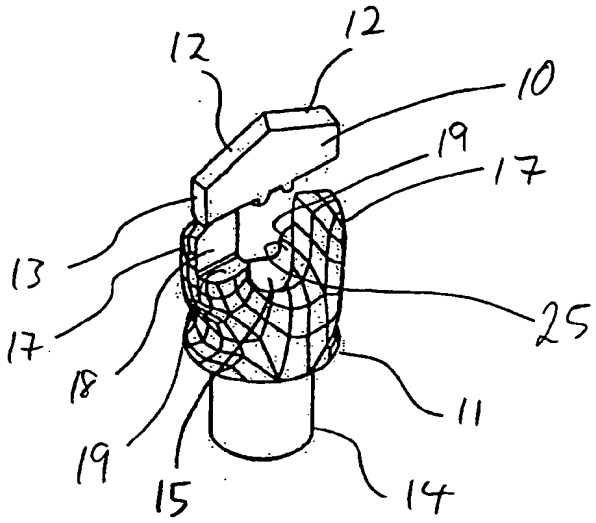

FIG 3

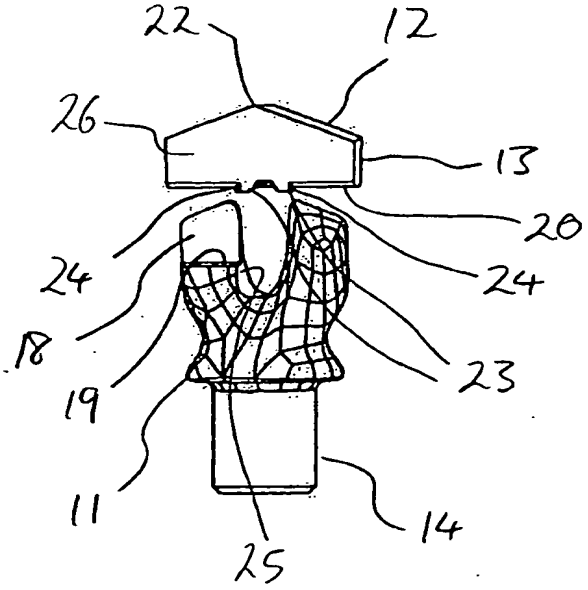

FIG 4

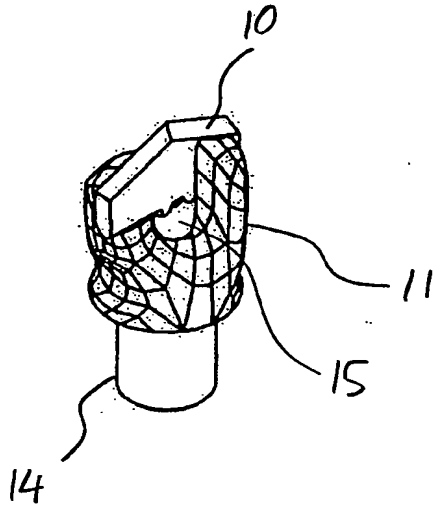

FIG 5

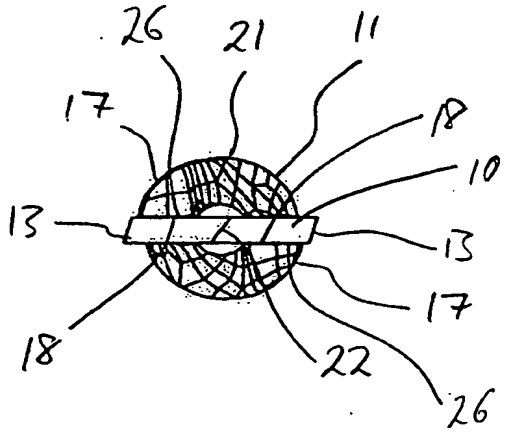

FIG 6